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Robo-advisors as a form of artificial intelligence in private customers' investment advisory services

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Abstract

The rapid expansion of artificial intelligence (AI) application areas is having a major impact on the environment that companies are operating in. AI offers many possibilities on revolutionising the wealth management industry. The utilisation of robots in wealth management and investment advising is an emerging trend across the industry. This paper focuses on personalised banking, examining the possibilities that artificial intelligence, more specifically robo-advisors, can offer in wealth management and investment advisory processes. The objective of this thesis is to provide the reader with a comprehensive understanding of the advantages and disadvantages in implementing an artificial intelligence-based investment advisory system taking also ethical aspects into account.

This thesis is to a large extent a literature review where objective observations are made based on existing literature. Moreover, Henri Kotiaho, who has worked on the development of investment and savings services at Nordea bank, was interviewed to gain empirical knowledge on how robo-advisors work in a real business environment. This interview provides insights on the empirical side throughout the thesis.

Considering the research question of investigating the advantages and disadvantages of AI application in investment advisory services for both the customer and the service provider, the following findings can be derived. For the customer, robo-advisors offer a better access to investment services, more convenient user experience and more affordable advisory service. However, there are some disadvantages for the customer related to these services, such as lack of personal contact and insufficient assessment of risk tolerance. On the other hand, for the service provider, robo-advisors provide cost-efficiency, enlarged customer base, steady income in terms of management fees, better service quality and easier trackability of transactions and procedures. Nevertheless, service providers also face certain challenges with these services, as the competition is increasing, the service requires high marketing investments and it is hard to predict whether there will be acceptance among customers for the automated services

Based on the discussed benefits and challenges a potential customer group for this kind of service can be found and a possibly best fitting model for arranging these services distinguished. The primary target group for these services is millennials who are starting to invest and save. The target group includes cost-conscious, underserved and long-term customers. Regarding the service-model different hybrid models seem to be the best solution, where the simplest services are provided by using automated services, but the more complicated advice is delivered as a personal service seems to have the highest potential in the foreseeable future.

When designing robo-advisory based investment advisory services, ethical questions in the advisory process, transparency and ethical investment recommendations must be taken into consideration. Suggestions for further research include user interface design, impacts on customer satisfaction and robo-advisors' performance in the long run and in volatile market conditions.

Keywords artificial intelligence, investment advice, robo-advisor

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1. Introduction

The rapid expansion of artificial intelligence (AI) application areas is having a major impact on the environment that companies are operating in, both internally and externally. Internally, AI will make it possible to conduct tasks better, faster and at a lower cost. Externally, AI will shape the company's relationship with its customers, other companies and the whole society. AI does not only have an impact on simple tasks but also on more complicated fields of services, such as consulting, law and financial services (Kaplan & Haenlein, 2019).

The digital revolution is shaping the traditional business environment in areas such as banking sector, asset management and insurance industries. The continuously developing technology has resulted in the emergence of the term FinTech, an abbreviation of financial technology (Mead, Pollari, Fortnum, Hughes, & Speier, 2018). FinTech firms use platforms, software and other technology to provide new digital online services which have traditionally been offered by the financial industry (Novick et al., 2016). Some of the key trends in FinTech include peer-to-peer lending, crowdfunding, blockchain and personal finance aka. wealth management (Novick et al., 2016). Facilitated by increasing digitalisation, artificial intelligence has found its application areas for example in credit decisions, risk management, fraud prevention, trading and personalised banking.

Digital investment advice is one example of an innovation of FinTech. Whereas today the interaction between investment advisors and investors still occurs mainly through personal contacts (Cocca, 2016), artificial intelligence offers many possibilities on revolutionising the wealth management industry.

Autonomous investment refers to many concepts, such as automated asset management, automated stock trading, algorithm trading and high frequency trading (De Castro & Annoni, 2017). The utilisation of robots in wealth management and investment advising is an emerging trend across the industry (Moulliet, Stolzenbach, Majonek, & Volker, 2016). It has been estimated by several well-known research institutes that in the year 2020, between \$ 2.2 trillion and \$ 3.7 trillion in assets will be managed with the support of robo-advisory systems (Moulliet et al., 2016). Furthermore, the potential in robo-advisory systems in the financial field has gained significant interest among venture capitalists and for instance, in 2015, venture capitalists invested around 300 million dollars in the business, trusting in the potential that the robo-advisory systems have in shaping the industry (Wong, 2015). Robo-advisors can be used in several fields in

financial asset management including account creation and goals setup, personal data analysis, recommendation for investing, communication between users for mutual investments, active trading and investing in ETFs (Exchange Traded Fund), stocks and bonds, protection of user's data, rebalancing of portfolio and retirement planning (Ivanov et al., 2018). These digital robo-advisors can have many different investment philosophies, methods and strategies. The algorithms can vary from a simple algorithm that provides a single portfolio to complicated multi-strategy algorithms that evaluate thousands of instruments and products to build a combined portfolio based on the customer's current holdings, risk tolerance and investment horizon (Novick et al., 2016). Even if there is a lot of hype around the AI theme and its opportunities in the investment advisory processes, implementing this kind of a service model must be evaluated clearly in terms of advantages and disadvantages and take the ethical questions, such as responsibility and transparency, into account.

This paper focuses on personalised banking, examining the possibilities that artificial intelligence, more specifically robo-advisors, can offer in wealth management and investment advisory processes. In more advanced applications, for example natural language processing (NLP) can be used to interpret written inputs, such as research documents, news stories and social media content, to create analyses that can be used to identify investment opportunities, simultaneously considering human behaviour (Ernst & Young, 2018). Different algorithm-based models can compare current market data to the information of past periods to potentially predict future market trends. A further example, chatbots are able to interpret and respond in various languages, allowing financial advisors to increase the scope of their client base (Ernst & Young, 2018) in resolving customers' routine questions in various languages and therefore saving the human advisors' time and increasing efficiency.

1.1 Research objectives and research questions

The primary research objective of this thesis is to analyse the benefits and challenges of using artificial intelligence, more specifically robo-advisors, in investment advisory processes. The aim is to research the benefits and challenges for both the investment advisory company and the customer. Furthermore, this thesis addresses also related ethical aspects, as ethical questions have been of rising interest in the private investment business for the past decade. In short, the objective of this thesis is to provide the reader

with a comprehensive understanding of the advantages and disadvantages in implementing an artificial intelligence-based investment advisory system.

The specific research questions of this thesis are thus the following;

RQ1: What are the benefits and challenges (drawbacks) for the customer of using robo-advisors in investment advisory services?

RQ2: What are the benefits and challenges (drawbacks) for the service provider of using robo-advisors in investment advisory services?

RQ3: What are the ethical aspects in using robo-advisors in investment advisory services?

1.2 Scope of research

In this research, the focus is on understanding the benefits that AI technology can offer in banking industry, more specifically in investment advisory processes for both the company and the customer. This research addresses the possibilities and challenges of robo-advisor systems on a generic level without comparing any specific robo-advisors existing in the market but using Nordea bank's application as a concrete example. The algorithms used, as well as the technical features of the applications and their implementation in companies, are outside the scope of this research.

The three key terms, which occur multiple times in the text throughout this thesis, are defined as follows:

Artificial intelligence: "A system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation" (Kaplan & Haenlein, 2019)

Investment advice: "Planning the allocation of the wealth of the client in various financial products. It includes advice relating to the purchase, sell or deal of investments products and advice on an investment portfolio of various assets like stocks, bonds, cash, mutual funds or other investment products. Investment advice can be written or oral or through other means of communication which can benefit the client in the long run." (Ghosh & Mahanti, 2014)

Robo-advisor: "A robo-adviser is an online investment platform that provides automated online investment advice and uses algorithms to determine asset allocations

and automated rebalancing for investors. Each client's portfolio is structured to achieve optimal returns at every level of risk" (Cocca, 2016). "A risk-tolerance questionnaire usually algorithmically determines an appropriate portfolio" (Wong, 2015).

1.3 Methodology

This research is conducted as a conceptual study, aiming to provide a comprehensive understanding of the possibilities and challenges artificial intelligence has in investment advisory processes. This thesis is to a large extent a literature review where objective observations are made based on existing literature. In addition, Henri Kotiaho, who has worked on the development of investment and savings services at Nordea bank, was interviewed to gain empirical knowledge on how robo-advisors work in a real business environment. All examples in this thesis referring to Nordea's robo-advisor "Nora service" are based on this interview. From the observations found in existing literature, as well as those based on the performed interview, a framework for analysing the aspects of using robo-advisors in wealth management is introduced. This thesis is constructed by using the funnel method, which means that the thesis is written by starting from a broad and general perspective before becoming more precise and dealing with more specific issues related to the topic.

In data acquisition, the Scopus database has been used as the main source of finding existing literature. This database was chosen because of its broad scope of management and engineering business-related studies relevant for the topic of this research. On Scopus, the searches were performed by typing different keywords and making valid restrictions to the search results. In addition, other databases such as Social Science Research Network (SSRN), Google Scholar, ACM, Springerlink and IEEE Xplore were utilised. The principles of gathering data from these sources are discussed in the following.

The Scopus database was the starting point for the database searches. Both backward and forward searching were utilised, meaning that research papers were found both by investigating the reference lists of the articles found and by looking at the documents citing a found document. On Scopus, the exact keyword, such as robo-advisory, investment advice and artificial intelligence, was searched from titles, abstract and keywords. Since the application of artificial intelligence in investment advisory services is relatively new, the articles considering this topic were published between years 2011 and 2019, most of them having been published less than four years ago.

The reliability of the collected background research information was ensured by checking that the institutions by which the researches were conducted are trustworthy and have a good reputation. In addition, the scientific articles were selected with the criterion that other researches had cited them before and used them as their reference, which further increases the trustworthiness of the data. Naturally, when searching for newer articles this latter criterion could not be utilised.

To get more empirical understanding of the topic of this thesis, an interview of a representative of a leading Nordic bank Nordea was arranged. For the interview with the developer Henri Kotiaho, the questions were prepared in line with the research questions formulated for this thesis. The interview was conducted in Vallila, Helsinki on 29.04.2019. The conversation was recorded in order to guarantee the correct expression of the statements in this thesis. Nora is used as an example of robo-advisors throughout this thesis to provide empirical information on how robo-advisors work in actual business environment.

1.4 Structure of research

This research is divided into six chapters. In the introduction chapter, the research questions, the scope of the research and the methodology are introduced. The second chapter discusses the theoretical background firstly of artificial intelligence, secondly investment advisory and finally robo-advisors. In the third chapter, benefits and challenges of using AI-based investment advisory are analysed from the customer's point of view and, in the fourth chapter, the same aspects are discussed from the service provider's standpoint. The fifth chapter concludes the findings of the previous chapters and, in addition, derives a potential customer group and a possible business model taking the aforementioned challenges and benefits into consideration. Finally, the sixth chapter focuses on ethical questions related to robo-advisory investment services, such as transparency and sustainable investments, and suggests future topics for research.

2. Theoretical background

In the following sections, the theoretical background of artificial intelligence, investment advisory and the basic idea of robo-advisors are discussed. At the end of this chapter, the history and features of Nora, the online robo-advisor of Nordea bank, are introduced based on the interview with Henri Kotiaho, the responsible developer of investment and savings services at Nordea bank.

2.1 Artificial intelligence

Artificial intelligence is rapidly changing the way we work and the business models in our society. Artificial intelligence is defined as “A system’s ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation” (Kaplan & Haenlein, 2019). The scientific research related to artificial intelligence is not a novelty but dates back as far as to the year 1960. A high number of research studies have been conducted on this topic ever since but in the 21st century, artificial intelligence it has gained more interest among researchers and engineers on how to apply it in different business service solutions.

AI consists of several fields including machine learning, deep learning, natural language processing (NLP) and robotics. The solutions based on artificial intelligence are linked to several academic branches, such as engineering, psychology, mathematics, computer science and linguistics. The vast processing capacity of machines has surpassed human limitations in many areas, such as medicine. The fast development in artificial intelligence has made it possible for machines to learn, take decisions on their own and provide better results. Already until now, AI solutions have had a significant impact on human life. The application areas of AI are endless, and this development will certainly change the lifestyle, working environment, methods of research and other aspects of modern society.

Artificial intelligence is often said to be one of the most revolutionary technologies impacting several industries and businesses. Among researchers and practitioners this development has even been compared to the industrial revolution of the 18th century (Rich & Knight, 2018). Since the 1960s, AI research has focused on five fields. The first field is reasoning which refers to the ability to solve problems through logical deduction. The second field is knowledge which includes the ability to represent knowledge about

the world. The third field is planning, including the ability to set and achieve goals. The fourth dimension is communication referring to the ability to understand written and spoken language and the fifth feature is perception which means the ability to deduce things about the world from visual images, sounds and other sensory inputs (Kelner, 2016)

The finance sector can serve as an example on how to apply the aforementioned five AI dimensions in real business models. In the financial markets, reasoning is applied in financial asset management and financial application processing. AI is for example used in making credit decisions where logical deduction is used in helping lenders differentiate between high default risk applicants and credit applicants who are credit-worthy but do not have an comprehensive credit history. The knowledge aspect, in turn, can be utilised in terms of financial market trading where Intelligent Trading Systems screen both structured (databases, spreadsheets, etc.) and unstructured (social media, news, etc.) data significantly faster than traditional people-based processing systems. The planning aspect is present in allocating assets to financial instruments with a long-term horizon. Especially this planning dimension can be seen in personalised banking and investment advisory. The communication feature can be applied in implementing intelligent agents, assistants and customer support in providing investment advice via chatbots or other communication channels. Finally, the ability to use up-to-date information of all market activities when deciding investment advice is an example of the perception field. Another example of the perception dimension is that AI can be used in risk management by designing algorithms that analyse the history of risk cases and identify early signs of potential future issues (Bachinskiy, 2019).

2.2 Investment advisory

The aim of personal savings and investment decisions is to obtain the highest possible return at a given risk level. Giving investment advice entails planning the allocation of the wealth of the customer in various financial products such as stocks, cash, mutual funds, bonds and other investment products (Ghosh & Mahanti, 2014). It also includes discretionary asset management, estate planning, retirement planning and tax planning. Investment advice can be given by oral or written communication. The goal of an investment analyst is to discover and implement the most desirable set of assets for an investor in the long run, according to his preferences (De Castro & Annoni, 2017).

The investment advisory problem can be recognised as a decision making problem under uncertainty and it can be divided into two categories (Ghosh & Mahanti, 2014). The first category is understanding the personal characteristics of the client and the second category is allocation of suitable assets to the customer portfolio. When giving investment advice the advisor must comply with regulatory and legal requirements and maintain a justification for every provided investment advice. New innovations have already shaped the investment advisory industry in recent years, driven by the constantly developing information technology and digitalisation, as well as the need to bring transparency and accessibility into the long-time established traditional wealth management (Jung, Glaser, & Köpplin, 2019).

Investing and saving money has become more relevant for a larger segment of society resulting in increased wealth in financial assets and growing participation in pension planning (Trumbull & Tufano, 2018). This change is being driven by for example new regulations, technological advances and changing demographics. The demand for financial advice has increased due to global and geopolitical uncertainty, low and negative interest rates and longer lifespans (Novick et al., 2016). Meanwhile, the supply of various investment products has increased and therefore, the investment process is often perceived as complicated and difficult. Seeking advice is a rational consequence of the perceived anxiety and lacked expertise in the financial field.

Robo-advisors are defined as “digital platforms that comprise interactive and intelligent user assistance components, using information technology to guide customers through an automated financial advisory process” (Jung et al. 2018; Sironi 2016; Ludden et al. 2015). In 2016, it was estimated that there were robo-advisors in fifteen different countries (Moulliet et al., 2016). The countries with the most sophisticated robo-advisory services include the United States, the United Kingdom and Germany (Huikko & Hykkönen, 2017). In 2017, there were around 60-70 robo-advisors in the EU, of which one-third were located in the United Kingdom and one-third in Germany (Kaya & Schildbach, 2017). The probably best-known robo-advisors are Betterment, Wealthfront, FutureAdvisor, Learnvest and Nutmeg (Vukovic & Bjerknes, 2017). A typical robo-advisory process consists of three phases. The first phase is initial investor screening, the second is implementation of investment strategies and the last one is monitoring and evaluating these strategies (Kaya & Schildbach, 2017).

2.3 How does a robo-advisor work?

Robo-advisor is defined as “an online investment platform that provides automated online investment advice and uses algorithms to determine asset allocations and automated rebalancing for investors. Each client’s portfolio is structured to achieve optimal returns at every level of risk” (Cocca, 2016). The basic design of robo-advisory services is usually similar across companies. The basic idea is to make the investors fill an online questionnaire. These questions are of key importance in creating a suitable investment portfolio for investors and to obtain compliance with the regulators. These questions can include for example age, monthly income, savings objective, level of financial instrument knowledge (ETFs, bonds, stocks etc.) and risk tolerance (Huikko & Hykkönen, 2017).

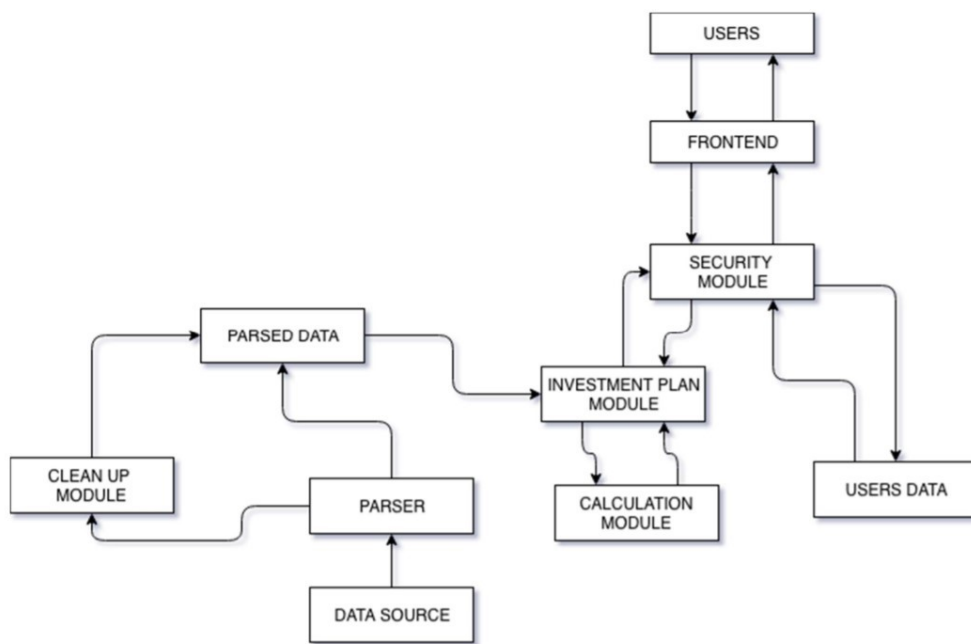


Fig. 1 Design for a general robo-advisor (Ivanov et al., 2018)

After the questionnaire has been completed to determine the customer’s risk-return profile, the Figure 1 above illustrates the high-level technical process of a general robo-advisor (Ivanov et al., 2018). First, the advisor takes data, for example stock data as an input. This data is used to create the investment plan combined with the customer’s risk preference, investment horizon and other aspects. The parser module extracts, transforms and loads the data to further modules. The appropriate and relevant data is transferred to the parsed data module and the invalid records are moved to the clean-up

module. The investment plan module creates the investment plans and keep them updated according to the calculations done in the calculation module. The security module is connected to investment plan module, frontend and user's data. The user's data module includes users' personal information and their investment plans. Security module ensures that the user's data is safe and not visible to third parties. The front-end module is the user interface of the robo-advisory system.

2.4 Basics of Nordea's robo-advisor Nora

Based on the interview of Henri Kotiaho from Nordea bank, the history and features of Nordea's robo-advisor Nora are introduced next. The development of Nora started two years ago, following the increasing trend of robo-advisors coming from the United States and other Nordic countries, such as Denmark, where Danske Bank launched their robo-advisor "June" a year before Nordea launched Nora. Nora is a common service for all the Nordic countries in which Nordea operates, and the user interface is translated into the language of the customer's choice. The main reasons behind developing online robo-advisory services are the increased regulation in banking industry, where digital platforms make it simpler to record all the necessary data, and the increasing use of technology which generates cost-efficiencies. According to Henri Kotiaho (2019, interview), Nora has three main features. The first one is testing the customer's knowledge about investing. The second feature is finding the right risk-return ratio for the customer and the third feature is providing the actual recommendation of the suitable investment portfolio for the customer.

The online questions of Nordea's Nora advisor are divided into three parts. The first part aims to make sure that the customer has enough understanding of investments and the mechanisms of the financial markets in general. The second part is the "getting to know the customer" part which includes questions about the customer's family situation, investable amount, present work situation, cash savings and liabilities. Finally, the third part asks investment related questions, such as the target return and risk levels and the customer's investment horizon to determine the optimal risk-return level of the investment portfolio. The application checks the consistency of the provided answers and highlights any inconsistencies prompting for a revision. After answering to the questions, the application determines the customer's desired risk-return level and classifies the customer into one of five categories.

Nordea's Nora advisor provides five different investment funds with varying risk levels and recommends the one which is best suited for the customer according to the answers to the online questionnaire. The diversified funds invest in both stocks and fixed income products, and their weights are in line with each risk level. Nora takes the customer's investable income into account and provides a recommendation on the euro amount to be invested in a chosen fund. While the overall principle appeared relatively simple, it was not possible to obtain much information on how the algorithms are programmed i.e. what logic the robo-advisor follows when planning the investment portfolios. This is mainly because the algorithms are part of the companies' business secrets which they do not want to reveal to the public. The basic process of robo-advisors is illustrated in Figure 2.

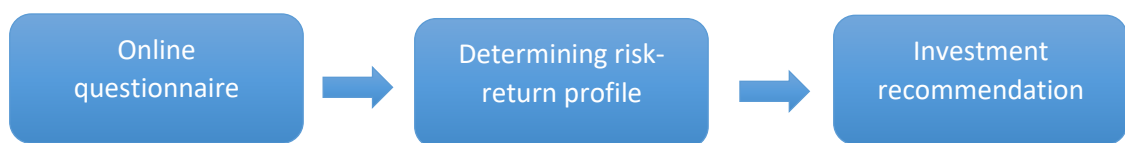


Fig. 2 *The basic process of a robo-advisor*

3. Benefits and challenges for the customer of using AI in investment advisory processes

Complexity of the advisory services, importance of the service to the customer and great importance of trust are all characteristics that need to be considered when offering online advisory services for investors. The robo-advisors whose technology is based on artificial intelligence create and invest in a portfolio taking the risk preference and investment horizon of the investor into account and additionally also manage the portfolio afterwards, being aware of market changes and variations of asset features and inform the investor of these changes affecting the individual's financial position (Jung et al., 2019). This technology can offer a substitute to traditional human based advice. A recent development in retail investment advisory services is the emergence of artificial intelligence to offer investment advice which are often subject to conflict of interest as their compensation is product neutral (Lewis, 2018). When using robo-advisors in the automated investment process, no human intervention in managing the portfolio is needed. The allocation of assets is based on quantitative optimisation. Therefore, the potential of using robo-advisors in investment advisory is an interesting technology possibly revolutionising the investment industry. The advantages and disadvantages of using this robo-advisory technology from the customer's point of view are discussed in the following.

3.1 Benefits for the customer

3.1.1 User experience

Robo-advisory systems simplify customers' user experience (Jung et al., 2019). Using online platforms to receive investment advice and online questionnaires to determine the risk preferences and investment horizons facilitates the investment process significantly from the customer's point of view. The continuous monitoring and automated rebalancing and 24/7 accessibility of robo-advisors differentiate them from traditional investment advisory services (Sironi, 2016). Customers can access their accounts via user-friendly smartphone applications or website and make adjustments to their portfolios anytime of the day and recalibrate the investments (Kaya & Schildbach, 2017). In addition, for example Nordea's robo-advisor Nora offers a chat feature which is always accessible, where customers get support if needed when using the actual robo-

advisor. Currently, there is a human investment advisor answering to these questions, but Nordea is planning on integrating their customer service chatbot Nova into Nora to make the process even more automated. These all-time accessible services are a significant advancement in service level, considering the trend of digitalisation and the resulting customer demand for flexible services.

Making investment decisions is usually considered as being complicated and difficult by customers. Moreover, these decisions are often affected by emotional and cognitive biases, such as overconfidence, and limited cognitive abilities (Lewis, 2018). As far as customer experience is concerned, robo-advisors offer simpler and less emotional decision-making processes. In contrast to traditional wealth management services, robo-advisors also provide a wider range of services, such as opportunity and risk alerts, push-notifications for market updates, and periodic portfolio reviews and dashboards which make the user experience more convenient (Jung, Dorner, Glaser, & Morana, 2018). According to Henri Kotiaho (2019, interview), one of robo-advisor Nora's main benefits for customers is that, due to its simplicity, it motivates customers to start investing and saving money earlier which, in turn, helps customers to plan and improve their financial situation. Easy access to investing through applications, such as Nora, addresses the problem that, for instance in Finland, about 76,6 billion euro are left on personal current accounts earning virtually no interest (Suomen Pankki, 2019).

3.1.2 Nonpersonal service

The common problem among investors is the lack of knowledge and the resulting overconfidence (Lewis, 2018). Therefore, the private and nonpersonal communication between the customer and the robo-advisor can serve as a safe platform for the customer to realistically understand their level of financial knowledge without the fear and embarrassment of showing this to a human advisor. On this note, robo-advisors can increase the transparency of the process, and hence, offer more neutral advice to the customer. Furthermore, using online questionnaires for determining the investment preferences of the customer, such as risk preferences and investment horizons, the investor is more likely to get the feeling that the advised portfolio is a result of logical reasoning which is not only a third-party's recommendation but more of a logical consequence based on the investor's own opinions (Sironi, 2016).

3.1.3 Conflict of interest

Human advisors are often considered to be subject to conflict of interest. This is mainly because their advice is affected by their own compensation offered by the employer whereas robo-advisors compensation is product-neutral (Lewis, 2018). Here, robo-advisors can be seen as a more ethical solution to investment advisory, as the conflict of interests is minimised, and the truly best advice is given to the customer based only on the available information of the customers' preferences and of the market and its changes. In addition, robo-advisors provide more transparency in terms of exposing the costs customers are paying via online fee analysers and alerts whenever new fees are charged (Lopez, Babic, & De La Ossa, 2015).

3.1.4 Advisory services available for a broader customer group

Robo-advisors make advisory services accessible to both affluent customers and investors with lower investable amounts. This is possible, as robo-advisors are designed to follow a low cost structure (Jung et al., 2019). Therefore, the emergence of robo-advisors have created a new low-budget investor class who traditional investment advisors have not served before (Jung et al., 2019). According to Henri Kotiaho (2019, interview), their robo-advisor Nora has increased investment activity especially amongst the customers who did not have any investments or savings before.

Traditional human financial advisors' annual fees are normally around 1 % for managing a portfolio up to \$100 000. For the same portfolio, the US robo-advisors charge 0,4 % on average, having a range between 0,15%-0,67%. Robo-advisors in the EU charge 0,8% on average for a similar investment, partly because of the higher asset management costs in the EU when compared to the US. Nordea's robo-advisor Nora is available free of charge but has a management fee ranging from 0,59% and 0,79% of the invested amounts. In addition, some robo-advisory services are free for investments up to \$10 000 and there are often no requirements for minimum volume when opening a robo-advisory account (Kaya & Schilbach, 2017). For example, Nordea's Nora service has a minimum investable amount of 10 euros. In 2016, up to half of the human financial advisors in the UK rejected customers because of the small size of the investments (Kaya & Schilbach, 2017). The following figure illustrates these differences in costs between traditional investment advisors, robo-advisors in the EU and robo-advisors in the US.

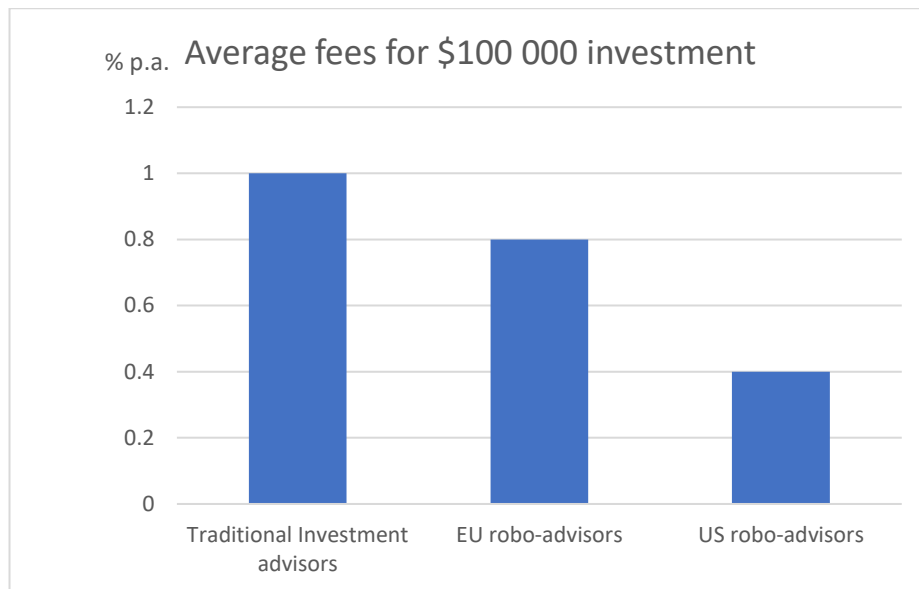


Fig. 3 *The average fees for a \$100 000 investment using traditional investment advisor, EU-robo-advisor and US robo-advisor (Kaya & Schildbach, 2017)*

3.2 Challenges for the customer

3.2.1 No personal contact, unfulfilled fiduciary duty

As far as wealth and money of the customers are concerned, customers tend to be more careful and alert when it comes to new technologies. Moreover, after dramatic life events, such as the death or illness, personal and supporting contact is often demanded by customers (Cocca, 2016). Also, at times of heavy market volatility, customers feel uncomfortable using robo-advisory services (Ludden, 2015). Based on studies conducted, the wealthier the person is, the more important a human advisor is (Cocca, 2016).

Robo-advisors make their investment suggestions based on an online questionnaire which can lead to recommendations that do not take all the necessary aspects of the investor's financial situation into account. This information could include relevant aspects such as the customer's contribution and withdrawal schedule, dependents, other sources of wealth, monthly expenses, tax situation and anticipated bigger expenditures (Fein, 2015). For example, Nordea's robo-advisor Nora cannot take into consideration unique life events such as receiving a large inheritance because of customised questions

that are similar for all customers. In these cases, customers should seek for personal advice.

3.2.2 Insufficient evaluation of risk tolerance and lack of personalisation

Whether the use of robo-advisors increases or decreases the conflict of interest among the service provider and customers is a matter of controversy in the existing literature. Robo-advisors keep contact with clearing firms, custodians, affiliated brokers and other companies in the industry in order to provide automated investment services for the customers.

As stated earlier, Lewis (2018) is of the view that robo-advisors eliminate this conflict of interest, whereas Jung et al. (2018) state in the article that this kind of an advisory system includes differing interests which may cause costs for the customer. For example, some companies use brokers of their choice which may result in not offering the favourable but a higher price for the investor (Fein, 2015). In other words, this means that a higher proportion of the price is transferred to the robo-advisor as profit. Fein (2015) also states in her report that some robo-advisors may also receive payments for order flow in exchange for routing trades to a clearing firm. She also points out that some of these robo-advisors reveal that they might have an interest in securities that are suggested to customers which also poses an additional conflict of interest such as commission payments for these particular instruments.

4. Benefits and Challenges for the service provider

Robo-advisors are increasingly gaining market-share in the wealth management industry and they have potential to revolutionise the investment advisory processes. This emerging trend drives traditional financial service providers to develop their services and platforms to keep up with the competition (Ernst & Young, 2018). In the following paragraphs, the benefits and existing challenges of using artificial intelligence in investment advisory processes are discussed from the service provider's point of view.

4.1 Benefits for the company

4.1.1 Costs and efficiency

Robo-advisory systems are currently mainly based on products that require no or only little active portfolio management, for example ETFs (Jung et al., 2018). ETFs do not require active decision-making by portfolio managers which makes their cost structure rather simple and easily manageable. Automated robo-advisors therefore reduce management, personnel and asset costs simultaneously making it possible to serve a larger customer group due to decreased prices of the service. This enables companies providing financial advisory services to reach a broader market segment which, in turn, can create more profits. Companies collect management fees on the invested funds regardless of the market ups or downs, thus providing steady income to the company.

Furthermore, the online questionnaires used for screening the investors is relatively straightforward and also less time consuming than traditional personal face-to-face discussions. (Kaya & Schildbach, 2017) Traditional investment advisory processes tend to be highly administrative and require repetitive data entries and unnecessary paperwork. However, it has been estimated that robo-advisors need to have near industry-leading cost-efficiency and a significant asset base to be profitable (Wong, 2015). The business-model based on robo-advisory services is also easily scalable making it an interesting business model alternative for the service provider (Jung et al., 2018)

4.1.2 Quality of the service

By using automated investment advisory systems, the customers are guaranteed to have access to information which is updated on a real-time basis. Robo-advisors are able to process, utilise and categorise the information significantly more efficiently than human advisors. Moreover, automated processes standardise the services offered for customers, which makes sure the customers are treated fairly and similarly in certain events, also reducing human error (Jung et al., 2019). The automated processes also make it easier to track the reasons behind every investment decision, since the algorithms provide recommendation in a highly consistent and logical manner. This facilitates the process of keeping online records of transactions and advice and handling possible customer complaints based on this information.

Kotiaho (2019, interview) pointed out that the robo-advisor Nora is highly consistent with the recommendations, which confirms that customers are treated fairly and similarly in similar situations. Kotiaho also mentioned that Nora gives highly valuable information about implementing and developing digital services which helps in designing and providing these services to other customer groups and fields of banking. In addition, Nora also makes sure all legal requirements of collecting information of the processes are documented correctly.

4.2 Challenges for the company

4.2.1 No acceptance by users

Despite the cost savings robo-advisory services offer for customers, these services tend to struggle with customer acceptance. Customers seem to prefer hybrid-models where they can search for information and compare products online but are still able to contact a human advisor before completing the final investment (Jung et al., 2018). Therefore, high marketing and advertising investments are required alongside with cheaper marketing options such as word of mouth and social media. A challenge can be that the investor group who has gained enough wealth to be interested in investing and saving are not willing to adapt new technologies and give up personal face-to-face advisory services. For example, Nordea has noticed that robo-advisory services are not enough for some customers, mainly for older generations. However, after becoming aware that robo-advisor Nora exists, many customers are willing to test it but not to use it to make

actual investments via this channel. Kotiaho admits that this is an area which needs improvements, that is, to design Nora to be more convenient for customers to actually make the investments based on Nora's recommendations.

4.2.2 High initial investment and marketing costs

Implementing a robo-advisory system requires a high initial investment but when the cost of developing the system has been met, the marginal cost related to each new transaction is relatively low (Wong, 2015). Hence, the service provider is able to benefit from economies of scale as more customers are adopting the service. For instance, one of Nordea's key reasons for developing their robo-advisor Nora has been the ability to reach larger customer groups, which also decreases the unit cost per transaction when the fixed costs are divided across more transactions.

Apart from development cost, providing new robo-advisory services require high marketing and advertising efforts resulting in client acquisition costs between \$300–\$1,000 per client, whereas some clients at the lower end may generate only about \$100 in annual revenues for the company (Ernst & Young, 2018). Robo-advisors need to use a big portion of the capital they produce to cover the tens to hundreds of millions of marketing dollars needed to gather assets and reach a profitable scale (Wong, 2015). According to Wong, even after they become profitable, robo-advisors' slim operating margin and low average account size imply that it could take a decade or more to reclaim the used advertising costs. Nordea also admits that it is a challenge to get customers to become knowledgeable about their robo-advisory service. Nordea, like many other banks, has tried to tackle this challenge by integrating the robo-advisory service to be part of the conventional banking services, such as their mobile bank.

4.2.3 Competitive environment

The new developments in technology have lowered barriers for new firms to break into wealth management. This competition is not only restricted to banking firms but includes also other fields, such as insurance firms and asset management firms, who add online investment advice to their range of services (Vincent, Laknidhi, Klein, & Gera, 2015). Moreover, also tech-based start-up companies are gaining more market share through new robo-based technological innovations. Therefore, traditional financial

service providers must be ready to change the services they offer based on these technologies and customer preferences. Then again, when these traditional financial service providers do start providing robo-advisory services, the competitive environment for FinTec start-ups will become harder, since they often do not have a large customer network. Under these circumstances, it has been estimated that robo-advisory start-ups are likely to shift from business-to-consumer services to business-to-business services (Kaya & Schildbach, 2017) establishing partnerships with existing asset management firms or banks. This new phenomenon of robo-advisors will have an impact especially on firms serving a mass client base, whereas companies targeting high-wealth customers preferring personal advice may be able to wait for the market to mature and their customers to adapt to the new technologies.

5. Results

Considering the research question of investigating the advantages and disadvantages of AI application in investment advisory services for both the customer and the service provider, the following findings can be derived. For the customer, robo-advisors offer a better access to investment services, more convenient user experience and more affordable advisory service. However, there are some disadvantages for the customer related to these services, such as lack of personal contact and insufficient assessment of risk tolerance. On the other hand, for the service provider, robo-advisors provide cost-efficiency, enlarged customer base, steady income in terms of management fees, better service quality and easier trackability of transactions and procedures. Nevertheless, service providers also face certain challenges with these services. As the competition is increasing, the service requires high marketing investments and it is hard to predict whether there will be acceptance among customers for the automated services. These benefits and challenges for both for the customer and the service provider are summarised in Table 1. Based on the discussed benefits and challenges of using AI in investment advisory services above, a potential customer group for this kind of service can be found and a possibly best fitting model for arranging these services distinguished.

Table 1. *Benefits and challenges to customers and service providers*

	Benefits	Challenges
Customer	<ul style="list-style-type: none">- Simple user experience- Nonpersonal service- Reduced conflict of interest- Advisory services available for a broader customer group	<ul style="list-style-type: none">- No personal contact- Insufficient evaluation of risk tolerance
Service provider	<ul style="list-style-type: none">- Lower costs and efficiency- Quality and consistency of the service	<ul style="list-style-type: none">- Non-acceptance by users- High initial investment and marketing costs- Competitive environment

5.1 Potential customers

There is no doubt that millennials (people born mid-1990s to early 2000s) are the primary target group for online investment advisory services. This target group is attracted by using new technology (Jung et al., 2019). Interestingly, technological affinity in private banking is strongly gender dependent as male private banking customers have a substantially higher affinity for technology than females (Cocca, 2016). This research finding offers an interesting basis when designing AI-based investment advisory systems. Furthermore, considering the still present need for personal advice with high investment volumes, the target group of robo-advisory systems are mainly cost-conscious and relatively underserved, long-term investors of discount brokerages (Wong, 2015). These investors feel anxiety when it comes to investing but who are not willing to pay for the full-service wealth management processes. According to Henri Kotiaho from Nordea, their robo-advisor Nora mainly targets millennials who are starting to invest and save. Nora is not designed for customers with higher wealth or high existing investments, since Nora cannot take these existing investments into consideration when recommending a suitable investment portfolio.

5.2 Hybrid model

In the light of the above, different hybrid-model solutions are likely to serve as the best alternative when designing robo-advisory based investment services. Based on the sources utilised in this literature review, it can be estimated that the long-term industry winners in wealth management industry will be those service providers who can, through customer segmentation, combine the efficiencies of AI and the personal requirements for trust and human understanding to add true value for customers. Personal contact is still important for the majority of private banking customers with higher investable amounts (Cocca, 2016). Therefore, regardless of the increased use of technology, a hybrid model, where the simplest services are provided by using automated services but the more complicated advice is delivered as a personal service seems to have the highest potential in the foreseeable future. Even if the robo-advisors are only at their beginning, wealth managers should react to this new technology, as this hybrid service model is likely to be the new norm (Vincent et al., 2015). After some years of development of the technology it could potentially be possible to create an avatar based system which could combine the capacity of processing information and bring the service available for customers by using a quasi-human face (Cocca, 2016).

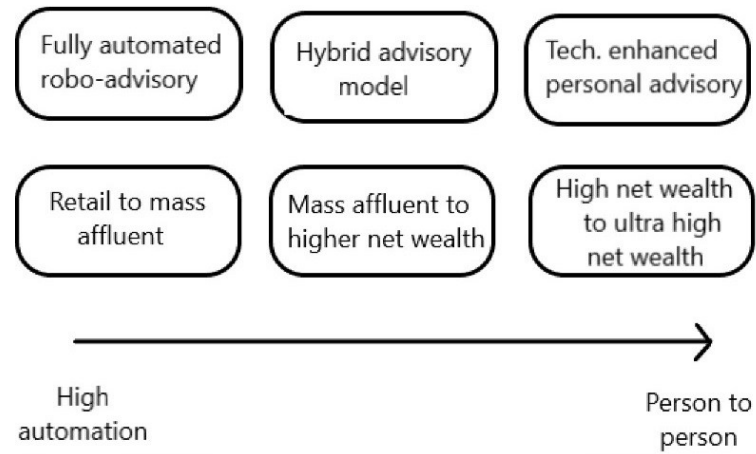


Fig. 4 *Emerging models for investment advisory* (Deloitte. & Avaloq, 2017)

Figure 4 above illustrates the customer group segmentation considering the investable amount. Fully automated robo-advisory services are mainly targeting retail and mass affluent investors, whereas hybrid advisory model is planned for investors with higher net wealth. Then again, for investors with high or ultra-high net wealth, personal advice is often demanded, and therefore, technology is utilised to enhance the quality of advice in these highly personal relationships.

Nordea's robo-advisor Nora also confirms this framework by being fully automated and targeting mass markets. Currently, the largest investable amount that the customer is able to invest via Nora in one go is 30 000 euros. Nora is currently not available for private banking customers who normally are wealthier, which also gives empirical evidence of how the automation level of the service and the target customer group are correlated. Nordea is planning on developing Nora to the hybrid advisory model where human advisors would be present in features that require a higher level of understanding of the customer's background and actual financial situation.

6. Discussion

The rapid growth of technology-based services often draws attention to the services' ethicality. As machine algorithms grow in all business areas, the law will continuously face questions of who will be responsible for progressively more independent and autonomous decision makers in case of mistakes and faults (Lightbourne, 2018). Corporate social responsibility (CSR) has become an important and integrated part of companies' everyday business and therefore, also ethical questions related to robo-advisors need to be considered carefully.

6.1 Ethical questions in the advisory process

Ethical questions related to investment advisory services can be divided into four categories (Ghosh & Mahanti, 2014). Firstly, the risk preference profiling of the customer should be done in a comprehensive manner to get the right understanding of the customer's risk preference. Robo-advisors have been criticised for making the risk preference profiling only based on online questionnaires which do not take all necessary financial information of the customer into account (Fein, 2015). Secondly, the offered products and services suggested to the client should be consistent with the client's risk preference. Robo-advisors make the investment recommendations based on algorithms derived from the customer's answers on the online questionnaires. Here, the logic and compatibility of the decision-making algorithms need to be ensured. Thirdly, customers should have understanding and knowledge of the financial services offered to them to be able to understand and bear the risks related to the various suggested financial products. It has been suggested AI-based advice first to offer education before offering expertise (Lewis, 2018). With this approach, consumers will understand the limits of their knowledge and be better in estimating the risks they are willing to take with their investment decisions.

Nordea has also integrated educational features on Nora. For example, if the customer has many consumer loans with high interest rates when planning on starting investing, Nora provides a suggestion to first pay back these credits before starting the investment activity. Nora also tries to make sure that the customer truly has enough information of the financial markets and understands the risks related to investing by asking virtually identical questions with different words when testing the customer's knowledge in the online questionnaires. Nora checks whether the answers are consistent with each other

which decreases the risk of providing financial recommendations to customers who do not understand the mechanisms behind these suggestions. Another reason for asking similar questions multiple times is to make sure that Nordea has understood the customer's real intentions and goals when providing investment recommendations. Finally, Ghosh and Mahanti (2014) argue that records of all advice should be maintained in order to ensure that the offered advice have a well-defined rationale and meet the customer's risk profile, suitability and knowledge.

Furthermore, in automated online advisory services, it is of utmost importance to take care of cybersecurity and to protect sensitive customer information and therefore, robo-advisors must establish controls and follow protocols to protect this data (Kaya & Schildbach, 2017). Now, the policy is that these digital advisory services follow the same rules as traditional financial services and are controlled and supervised by the same authorities. This means that robo-advisors are subject to the supervision by SEC and FINRA in the US, the FCA in the UK and equivalent supervisory authorities in other countries (Novick et al., 2016). To tackle the mistrust among customers, for example, creating a compensation fund in case of negative events could ease the victims' anxiety. These procedures could also offer protection to service providers, manufacturers and developers by providing restricted liability in response for the payments to the fund (Lightbourne, 2018). All in all, lawmakers should not create a short-term solution and, in so doing, forget to investigate the long-term consequences and solutions to the more complicated legal questions related to completely automated algorithms (Lightbourne, 2018).

6.2 Transparency

The new technology in investment advisory and the increasing demand for investment advisory services have resulted in a growing need for process transparency. The main source of criticism for the now-available financial advice services is the lack of transparency and comprehensibility of advisory services, in other words the activities performed therein, their interrelations as well as their results (Nussbaumer & Matter, 2011). This lack affects customer satisfaction, as the reasoning behind processes is not clear and hence, a long-term trust-based relationship is not established. As pointed out by Cocca, trust is a key aspect in financial management and the advisory only creates value when the recipient of the advice has a strong feeling of trust (Cocca, 2016). The main reason for the perceived lack of trust among customers is the lack of reasoning

behind decisions and information asymmetry between the advisory process parties (Nussbaumer & Matter, 2011).

6.3 Ethical investment recommendations

Customers are becoming increasingly interested in responsible and sustainable investing. This means that especially environmental, social and governmental factors are taken into account in investment decisions (ESG investing). For each of these aspects, information is gathered on the company's policies and practises (van Duuren, Plantinga, & Scholtens, 2016). This information is then collected and analysed to create a diversified portfolio. In robo-advisory systems, these ethical questions should be taken into account when creating the portfolio for the customer in order for the customer to have an alternative to make ESG investments according to their preferences.

Nordea has already launched the next version of the robo-advisor Nora in Sweden where more investment alternatives have been added. One added alternative is designed for customers who are highly interested in responsible investing. In this alternative, on one hand, certain firms and industries are excluded from the portfolio and, on the other hand, especially firms ranking high in responsibility and sustainability are sought and added to the portfolio. In other words, Nordea uses two ESG strategies, namely negative screening and positive screening (van Duuren et al., 2016).

6.4 Future research

Robo-advisors are a relatively young phenomenon in finance, wealth management and information systems and hence, only few researches on robo-advisory have been conducted (Jung, 2018). Based on the research of existing literature conducted on the present topic of using artificial intelligence in investment advisory services, there are some gaps which are suggested to be filled with further research. First of all, further research in user interface design is necessary to guarantee an easy and functioning investment platform for customers. Further research could address themes, such as the platform's main features, visual design and support functions.

Secondly, a remarkably little researched question in this area is the impact of using robo-advisors on the customer experience and customer satisfaction. This is probably one of

the most important topics for further research, since it is an aspect straight affecting the customer acceptance and thereby profitability of these kind of services provided.

When asking about Nordea robo-advisor's impact on customer satisfaction, Kotiaho could not provide any empirical statistics, as the service is relatively new. However, he points out that when asking about customer experience, it is often hard for customers to distinguish the difference between features of the actual advisory service platform and the financial performance of the investment portfolio.

Thirdly, there is relatively little research done on how robo-advisors perform in volatile market conditions and how profitable the investment proposals suggested by robo-advisors are in the long-term. Further research is required to determine whether robo-advisors perform better than traditional human advisors. In addition, measuring differences in psychological factors in decision-making when using robo-advisors and traditional human advisors would be an interesting topic for further studying.

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Interview

Kotiaho Henri, developer of investment and savings services, Nordea, 29.04.2019, Helsinki